Science Literacy for ALL Students
The Rhode Island State Science Framework

Science Literacy for All Students - The Rhode Island State Science Framework is the end product of the work of hundreds of individuals across the state over the past three years. This effort was also informed by advice from a statewide Frameworks Advisory Committee comprised of over 40 individuals representing a broad spectrum of organizations, public and private, across the state.

The framework development team was composed of 89 individuals from public and private K-12 schools across the state, university and college educators and scientists, and representatives from business, industry, and the RI Department of Elementary and Secondary Education. Broad support for the effort was also received from many organizations, including the Rhode Island Science Teachers Association, the Rhode Island Environmental Educators Association, and the American Association for the Advancement of Science.

The framework is directly linked to Project 2061 of the American Association for the Advancement of Science, a major national reform initiative in mathematics, science, and technology education. Project 2061 has a lead document, Science for All Americans, which describes what every American student should know, be able to do, and value in the sciences. This document was based on careful work by panels of experts in various scientific fields which defined key concepts and principles in their respective fields of endeavor. The RI science framework development team accepted the deliberations and recommendations of Science for All Americans as a common starting point for its work.

A second document from Project 2061, Benchmarks for Science Literacy, offers 855 curriculum benchmarks organized into grade levels of K-2, 3-5, 6-8, and 9-12. It was compiled by a team of several hundred science teachers and scientists from across the nation, as well as reviewed by thousands of others in draft form.

The science framework committee carefully considered this document and concluded that RI schools, administrators, and teachers would benefit from linking their science education efforts directly to relevant Project 2061 benchmarks for the following reasons. First, because the benchmarks reflect the best collective thinking of the science community regarding standards for K-12 science education. Second, because Project 2061 is committed to linking concepts and principles not only across the sciences (e.g., biology, chemistry, astronomy, oceanography, mathematics) but also to other important areas of human endeavor such as history, philosophy, communication arts, engineering and allied fields, and the social sciences. Sustained use of the Benchmarks for Science Literacy enables schools to appropriately tailor their

efforts to reflect local concerns and needs while ensuring that such efforts in the science curriculum area are linked to rigorous, nationally agreed-upon standards in science education.

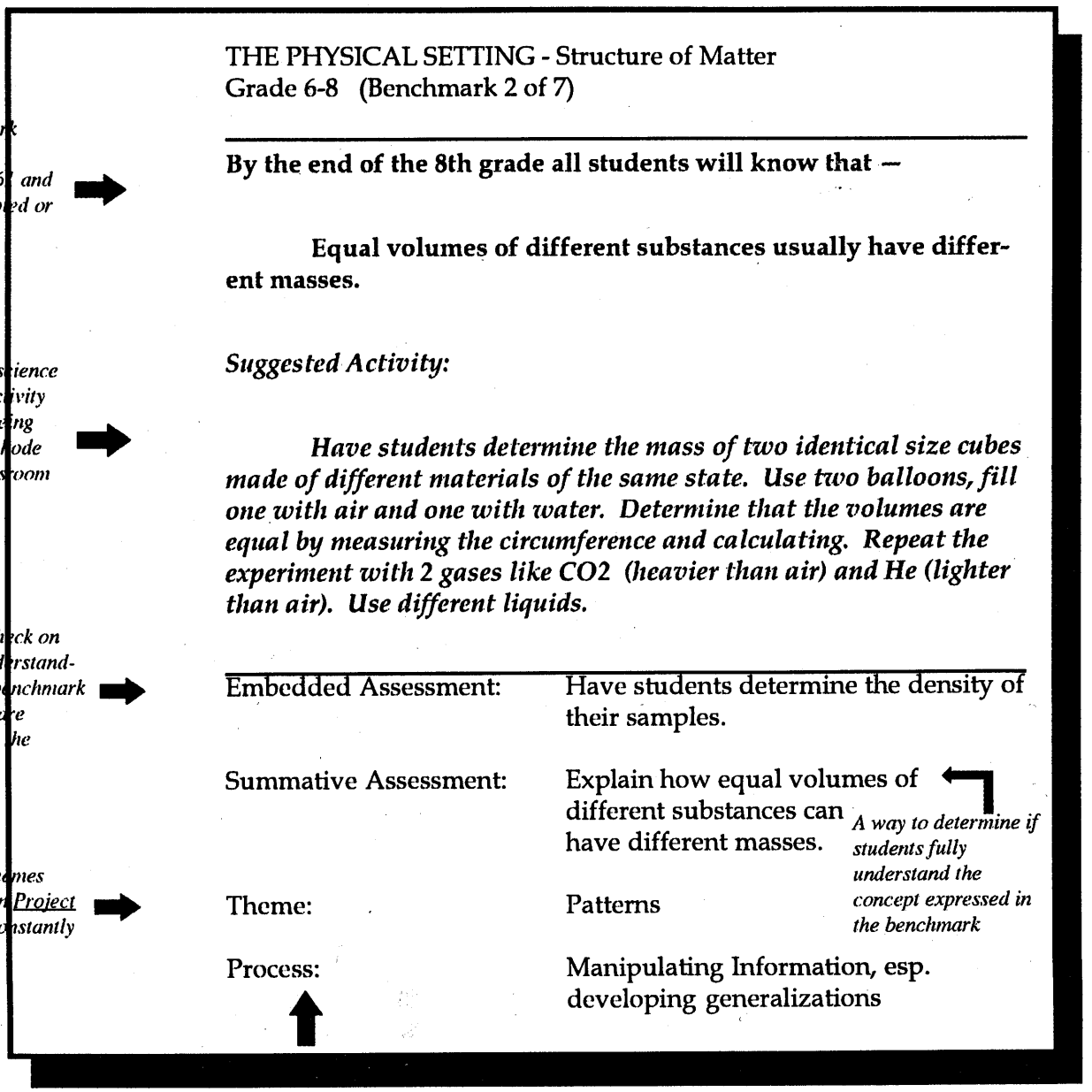
The benchmarks have been carefully organized to reflect cross-linkages of concepts among the sciences and with other disciplines. The major chapters and their subheadings are:
1. The Nature of Science: the scientific world view, scientific inquiry, the scientific enterprise.
2. The Nature of Mathematics: patterns and relationships, mathematics, science, and technology, mathematical inquiry.
3. The Nature of Technology: technology and science, design and systems, issues in technology.
4. The Physical Setting: the universe, the earth, processes that shape the earth, structure of matter, energy transformations, motion, forces of nature.
5. The Living Environment: diversity of life, heredity, cells, interdependence of life, flow of matter and energy, evolution of life.
6. The Human Organism: human identity, human development, basic functions, learning, physical health, mental health.
7. Human Society: cultural effects on behavior, group behavior, social change, social trade-offs, political and economic systems, social conflict, global interdependence.
8. The Designed World: agriculture, materials and manufacturing, energy sources and use, communication, information processing, health technology.
9. The Mathematical World: numbers, symbolic relationships, shapes, uncertainty, reasoning.
10. Historical Perspectives: displacing the earth from the center of the universe, uniting the heavens and the earth, relating matter and energy and time and space, extending time, moving the continents, understanding fire, splitting the atom, explaining the diversity of life, discovering germs, harnessing power.
11. Common Themes: systems, models, constancy and change, scale.
12. Habits of Mind: values and attitudes, computation and estimation, manipulation and observations, communication skills, critical-response skills.

The work of Project 2061 has dramatically influenced work on the national science standards (about 80% of it is virtually identical to the benchmarks), state science frameworks, and assessment projects like the National Assessment for Educational Progress (NAEP) and the New Standards Project, whose science performance standards are directly tied to Project 2061 (RI is a partner in both assessment projects).

The framework development committee adopted the Project 2061 Benchmarks as its foundation. The development team enhanced 2061's focus on the science curriculum by featuring engaging science activities currently taught in selected RI schools linked to particular benchmarks. In addition, the framework provides background materials and supplemental resources to assist schools in reforming their science education efforts:
* chapters presenting a philosophy of education and definitions of key terms used in the framework, issues of equity and access, assessment concerns, professional development considerations, program evaluation suggestions, and curriculum analysis and change.
* a systematic approach to science process skills with a taxonomy which shows their relationship to science teaching and learning.
* a resource section which lists organizations and information delineated by organizations found within the state, those located in adjacent states, and national and international organizations.
* useful curriculum materials in science which promote the teaching of science in a hands-on, minds-on manner consistent with the focus of the framework and the 2061 Benchmarks.

All principals, district superintendents, assistant superintendents, directors of curriculum, Regents, collaborative directors and specialists, and members of the framework development team have received a copy of the framework. Its pages can be reproduced by schools and school districts and used in a wide variety of ways to promote quality instruction in science. Members of the framework team and state education department staff are available to work with schools and districts in understanding and implementing the framework. For further information or to schedule assistance call 277-2821, ext. 2150 and leave a detailed message or send an e-mail to ststoday@aol.com. The Department of Education is interested in obtaining copies of any local curriculum documents, units, or activities you develop in light of the framework. These items can be mailed to Mathematics, Science & Technology Programs, RI Department of Elementary and Secondary Education, Shepard Building, 255 Westminster Street, Providence, RI 02903-3400. We hope to also make these available electronically along with instructional vignettes keyed to specific benchmarks in the near future.

A SAMPLE PAGE FROM THE RI SCIENCE FRAMEWORK ...



THE PHYSICAL SETTING - Structure of Matter
Grade 6-8 (Benchmark 2 of 7)

A benchmark taken from Project 2061 and either adapted or adopted

By the end of the 8th grade all students will know that —

Equal volumes of different substances usually have different masses.

A real-life science teaching activity currently being used in a Rhode Island classroom

Suggested Activity:

Have students determine the mass of two identical size cubes made of different materials of the same state. Use two balloons, fill one with air and one with water. Determine that the volumes are equal by measuring the circumference and calculating. Repeat the experiment with 2 gases like CO2 (heavier than air) and He (lighter than air). Use different liquids.

A way to check on student understanding of the benchmark while they are engaged in the activity

Embedded Assessment:	Have students determine the density of their samples.
Summative Assessment:	Explain how equal volumes of different substances can have different masses.
Theme:	Patterns
Process:	Manipulating Information, esp. developing generalizations

A way to determine if students fully understand the concept expressed in the benchmark

The 'big' themes identified in Project 2061 are constantly reinforced.

The science framework address process skills in a way that makes them meaningful to classroom teachers and curriculum developers.

The science framework directly builds upon the state's Common Core of Learning. The Common Core describes what every graduate of Rhode Island schools should know and be able to do in the arenas of Communication, Problem-Solving, Body of Knowledge, and Responsibility. The learning goals of the Common Core are realized through the school curriculum, learning activities, and assessment tasks. The activity above, for example, increases a student's Body of Knowledge. It focuses primarily on developing student understanding of the relationships between volume and mass. If students communicate their results and understandings to one another throughout the activity, it also provides opportunity to improve communication skills.

A 'Classroom Vignette' Related to the Benchmark ...

From Mr. Palano's class, Northern Cumberland Middle School, Cumberland ...

Mr. Palano's second class of the day is his smallest, only eight students with a classroom aide. While teaching the concepts of density, mass and volume he is using a Computer Assisted Science Labs package. Students are instructed to select a variety of wooden blocks, measure the mass and volume using rulers and a triple-beam balance, and finally calculate the density. They work in pairs. As each pair completes a set of calculations, they move to a special computer workstation attached to a scale. They place their wooden block on the scale and enter their calculated values in the computer. In seconds the accurate results (mass, density and volume) are displayed on the screen, along with an accuracy rating from 0 to 5. Students know immediately if their measurements were very exact (rating of 4.7 or more), if they were close but not terribly accurate (between 4.2 and 4.7) or if they have made an error somewhere along the line. When they score below a 4.7 they go back to their stations and try to identify the problem. Mr. Palano circulates around the room, offering helpful advice at each station. Students let out a little cheer when the computer verifies their measurements as accurate. This activity will be repeated throughout the day with Mr. Palano's other classes. What makes this class unique is that the students are in a self-contained classroom for the rest of the day. Keeping the class size small and having a familiar classroom aide allows these students to fully participate in the eighth grade science laboratory experiences.

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